

OPTICAL BIOPSY SHINES NEW LIGHT ON CANCER

A new laser-based biopsy procedure can diagnose cancer of the esophagus almost instantaneously without the pain of tissue sampling.



■ Instead of using a pincer-tipped cable (pictured in foreground), researchers have developed a new, laser-based, nonsurgical method to diagnose certain cancers, such as esophageal cancer.

It was 18 years ago that retired engineer Melvin Francis first noticed something was wrong. “I had burning sensations in my throat,” he recalls. With the aid of an endoscope, Dr. Bergein Overholt diagnosed the problem as Barrett’s esophagus, a precancerous condition in which the lining of the esophagus is severely irritated.

After the surgery to remove the precancerous abnormalities, Dr. Overholt began a series of biopsies to analyze the tissue in Francis’ esophagus. These procedures removed samples of sensitive esophageal lining and were quite painful, according to Francis. And obtaining the results took days, producing many anxious moments for him and his family. This scenario is typical for many others diagnosed with esophageal cancer.

Working with Dr. Overholt and research scientist Dr. Masoud Panjehpour, Dr. Tuan Vo-Dinh of Oak Ridge National Laboratory (ORNL; Oak Ridge, TN) has developed a new, fast, noninvasive fiber-optic probe to detect cancer of the esophagus. The probe induces and detects fluorescence of the tissue and can determine whether or not suspicious lesions are cancerous. It yields diagnoses noninvasively, without biting into tissue the way a conventional biopsy does. And it produces diagnoses fast, without the delay of sending away samples for evaluation and waiting for a pathologist’s report.

Tissue’s glow analyzed. The probe substitutes light for the scalpel of surgical biopsy. Using the body’s own light emission in reaction to certain wavelengths of laser light, a spectrometer, an instrument for visualizing light emitted from an organ’s tissue, can detect unique fluorescent signals. As demonstrated in studies conducted by the probe’s developers, this activity can reveal cancerous hot spots without removing tissue. Dr. Vo-Dinh first realized the potential of this technology while using lasers to conduct data storage experiments for BMDO and environmental monitoring studies for the Department of Energy. BMDO’s experiments focused on a new technology for optically storing vast amounts of computer data, called surface-enhanced Raman optical data storage.

The optical probe technology could change the course of medicine in diagnosing certain tumors. “Optical biopsies are noninvasive and fast because no tissue is removed and the diagnosis can be made almost immediately,” says Dr. Vo-Dinh, ORNL’s division leader for the Life Sciences Group. “Conventional tumor

biopsy requires the use of a pincer-tipped cable to physically remove tissue for analysis. Such a procedure entails recovery time for patients and an expensive, time-consuming laboratory analysis to determine malignancy.”

In the new method, instead of the biopsy “pincer” cable, a fiber-optic cable is inserted in the biopsy channel of an endoscope. Laser light is directed through the cable’s optical fibers onto the tissue. The tissue absorbs the laser light and, depending on the light’s wavelength, re-emits it as a fluorescent “glow,” which is spectrally analyzed. Using a special data analysis method, the researchers discovered that the spectral “fingerprint” of a malignant tumor can be distinguished from that of a noncancerous tumor.

Highly accurate. The probe technology was put to the test against standard mechanical biopsies at the Thompson Cancer Survival Center in Knoxville, Tennessee. In a research investigation involving 100 patients, the technology accurately diagnosed 98 percent of all esophageal tumors. In fact, in one case, the mechanical biopsy was normal, but the optical biopsy detected a malignancy.

The technology has been licensed to Venture Alliance (Knoxville, TN), a venture development company that invests in and manages early-stage technologies, particularly those for the medical industry. Venture Alliance formed Optical Biopsy Technologies, L.L.C., to further develop and commercialize the optical probe technology. Working with the U.S. Food and Drug Administration, Optical Biopsy Technologies has completed pilot clinical studies for both gastrointestinal (GI) and cervical applications and has received an investigational device exemption for the GI application. The company is currently seeking additional investors.

Vo-Dinh’s BMDO-funded research and development in optical data storage also led to the development of a surface-enhanced Raman gene probe (SERGen). The probe requires no radioactive tags or special fluorescing dyes and cuts gene identification time drastically, from as many as 16 hours to a matter of minutes. Because of its speed and sensitivity, the probe could prove useful in many areas.

For example, in our era of increasing antibiotic resistance, SERGen may prove a boon to doctors who want to quickly identify resistant organisms. Doctors can then prescribe the proper medication and avoid a wasted course of ineffective antibiotics. SERGen also could offer a drastic improvement in the methodology used for gene sequencing and identification, such as that being applied in the Human Genome Project.

■ For more information, contact Dr. Tuan Vo-Dinh of ORNL via telephone at (423) 574-6249 or via E-mail at tvo@ornl.gov. You can also visit ORNL’s Web site at <http://www.ornl.gov>. Or, contact Robert Lundgren of Venture Alliance via telephone at (423) 523-2346 or via E-mail at lundgren@venturealliance.com.



What Does It Mean to You?

Optical biopsy can help to diagnose cancers earlier and before they have had a chance to spread, and can also alert the clinician to precancerous conditions that can thereafter be carefully monitored.



What Does It Mean to Our Nation?

Optical biopsy is an emerging technique that can be performed at a cost 10 times cheaper than conventional biopsies, reducing the cost of specialized medical care for cancer patients.

Tech Trivia

- Which of the following does not describe Chandrasekhara Venkata Raman, who discovered Raman spectroscopy?
- A. A Nobel Prize winner
 - B. An assistant accountant
 - C. A British knight
 - D. A famous tiger hunter

For the answer, see page 73.